Big Data and Clouds: Challenges and Opportunities

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Charge to Presenters

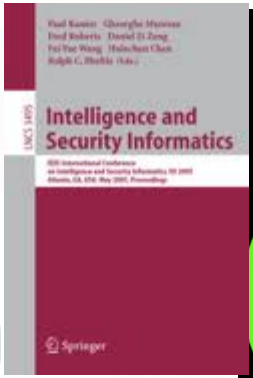
- Discuss opportunities and challenges presented by the intersection of cloud and big data.
- For example, on the opportunity side we have been thinking about the ability of cloud to make big data approaches feasible and cost-effective for small and medium enterprises and for the combination to enable new, data-as-a-service business models.
- On the challenge side, we have been thinking about how “bring-the-computation-to-the-data-rather-than-the-data-to-the-computation” approaches could work in cloud environments and what quality metrics and measurement methods could work across heterogeneous data types of uncertain provenance, including methods for quality discovery.
- These are just examples and we are very interested in hearing your take on the intersection of cloud and big data.

Some Topics

- Curricula
- Consensus on Architecture and value of clouds
- High Performance Library
- FutureGrid

Education and Training

- Microsoft says there will be **14 million cloud jobs** around the world by 2015
- McKinsey says that there will up to **190,000 nerds** and **1.5 million extra managers** needed in Data Science by 2018 in USA
- Many more jobs than simulation (third paradigm) where **computational science** not very successful as curriculum
- Need curricula to educate people to use/design **Clouds** running **Data Analytics** processing **Big Data** to solve problems in **X-Informatics** (X= Bio…LifeStyle…Policy…Wealth)
- Cover Data curation/management, Analytics (algorithms), run-time (MapReduce, Workflow, NOSQL), Applications
- Not many courses aimed at any one aspect of this; let alone everything and their integration
- Look at Massive Open Online Courses (**MOOCs**)


Paul Kantor · Gheorghe Muresan
Fred Roberts · Daniel D. Zeng
Fei-Yue Wang · Hsinchun Chen
Ralph C. Merkle (Eds.)
LNCS 3495
Intelligence and Security Informatics
IEEE International Conference
on Intelligence and Security Informatics, ISI 2005
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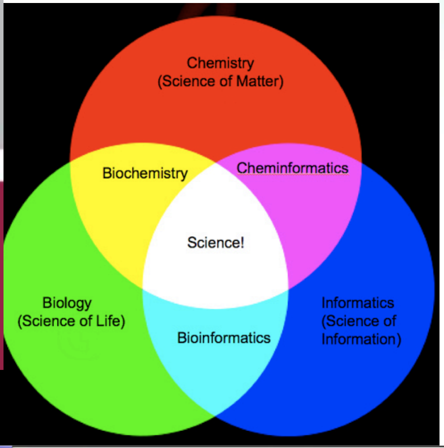

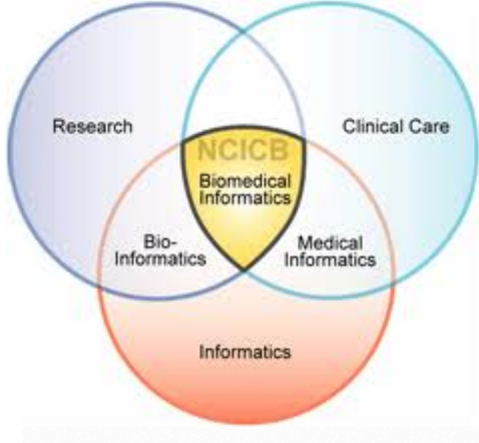

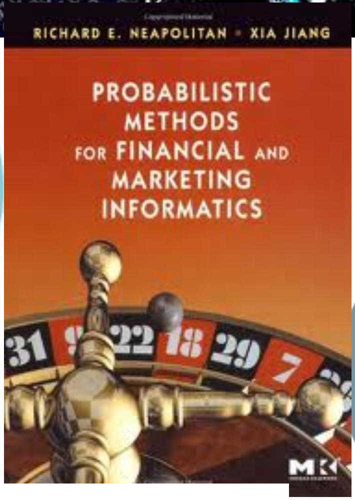
RICHARD E. NEAPOLITAN • XIA JIANG
PROBABILISTIC METHODS FOR FINANCIAL AND MARKETING INFORMATICS
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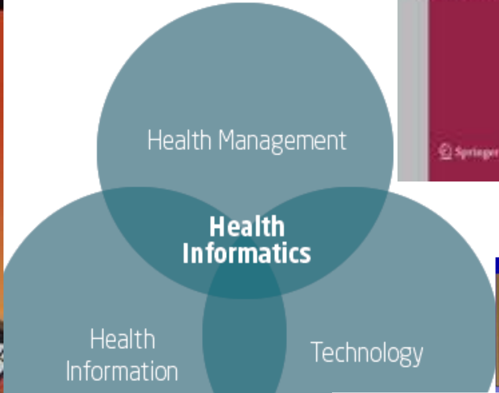

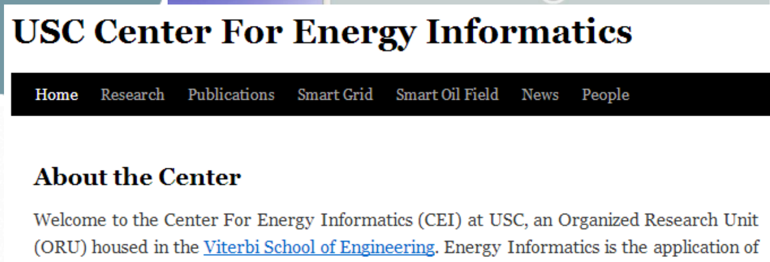

USC Center For Energy Informatics

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About the Center

Welcome to the Center For Energy Informatics (CEI) at USC, an Organized Research Unit (ORU) housed in the Viterbi School of Engineering. Energy Informatics is the application of info

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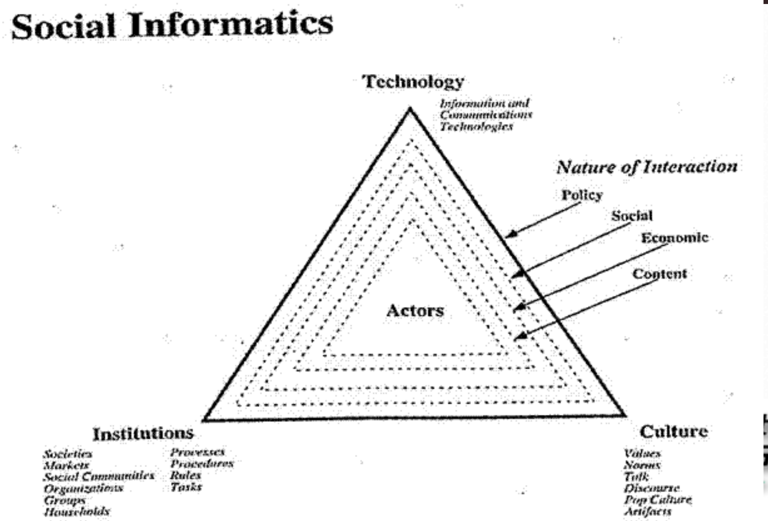
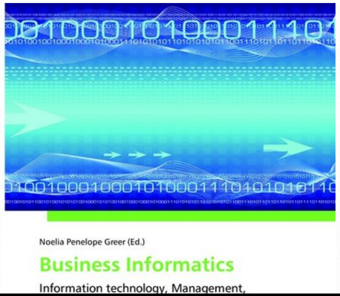
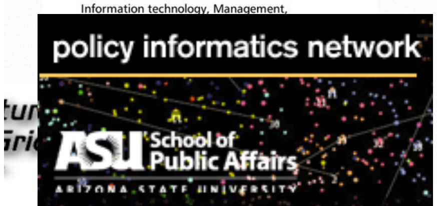
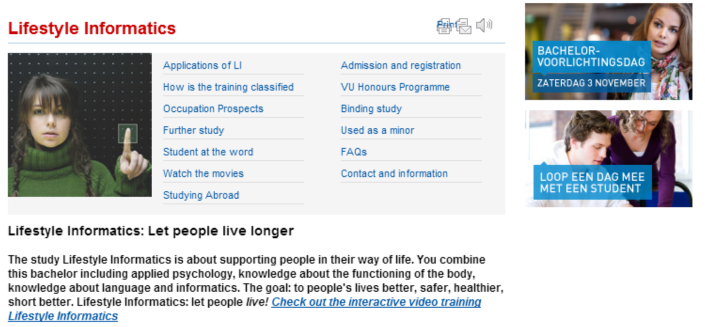



Noelia Penelope Greer (Ed.)
Business Informatics
Information technology, Management,





Lifestyle Informatics

Print

- Applications of LI
- How is the training classified
- Occupation Prospects
- Further study
- Student at the word
- Watch the movies
- Studying Abroad
- Admission and registration
- VU Honours Programme
- Binding study
- Used as a minor
- FAQs
- Contact and information

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Lifestyle Informatics: Let people live longer

The study Lifestyle Informatics is about supporting people in their way of life. You combine this bachelor including applied psychology, knowledge about the functioning of the body, knowledge about language and informatics. The goal: to people's lives better, safer, healthier, short better. Lifestyle Informatics: let people *live!* *Check out the interactive video training Lifestyle Informatics*

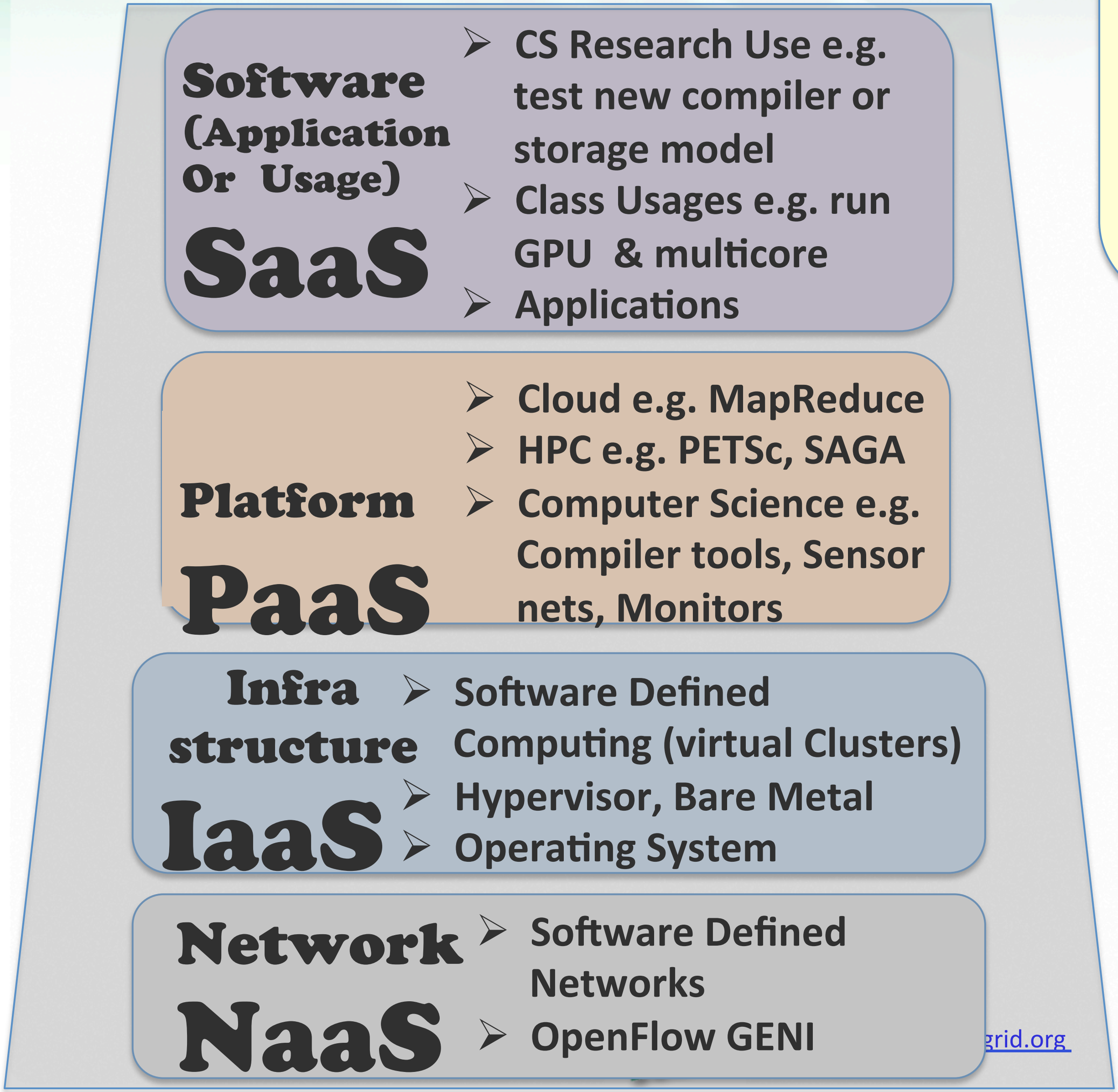
Clouds for Scientific Data Analysis

- There has been plenty of trials and several successes from particle physics (LHC) data analysis to genome sequencing
- **MapReduce/NOSQL** with Iterative extensions good for data intensive problems which have very different communication requirements from large scale simulations
  - Large collective communication v. smallish local messages
- However no agreement on good data architecture or even requirements for this either in cloud or on conventional HPC style systems
- No agreement on value of commercial clouds as cost effective solution
- **Need to generate a consensus on data architectures as exists for simulations**
  - Exascale discussion builds on agreed principles

Data Analytics Futures?

- **Better algorithms** contribute as much as **better hardware** in HPC
- **PETSc** and **ScaLAPACK** and similar libraries very important in supporting parallel simulations
- Need equivalent **Data Analytics libraries**
- Include **datamining** (Clustering, SVM, HMM, Bayesian Nets …), **image processing**, **information retrieval** including **hidden factor** analysis (LDA), **global inference**, **dimension reduction**
  - Many libraries/toolkits (R, Matlab) and web sites (BLAST) but typically not aimed at scalable high performance algorithms
- Should support **clouds and HPC; MPI** and **MapReduce**
  - Iterative MapReduce an interesting runtime; Hadoop has many limitations
- Need a **coordinated Academic Business Government Collaboration to build robust algorithms that scale well**
- Propose to build community to define & implement **SPIDAL** or **Scalable Parallel Interoperable Data Analytics Library**

FutureGrid offers Computing Testbed as a Service



Software (Application Or Usage)

SaaS

- CS Research Use e.g. test new compiler or storage model
- Class Usages e.g. run GPU & multicore
- Applications

Platform

PaaS

- Cloud e.g. MapReduce
- HPC e.g. PETSc, SAGA
- Computer Science e.g. Compiler tools, Sensor nets, Monitors

Infra structure

IaaS

- Software Defined Computing (virtual Clusters)
- Hypervisor, Bare Metal
- Operating System

Network

NaaS

- Software Defined Networks
- OpenFlow GENI

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FutureGrid Uses Testbed-aaS Tools

- **Provisioning**
- **Image Management**
- **IaaS Interoperability**
- **NaaS, IaaS tools**
- **Expt management**
- **Dynamic IaaS NaaS**
- **Devops**

FutureGrid Usages

- **Computer Science**
- **Applications** and understanding **Science Clouds**
- **Technology Evaluation** including XSEDE testing
- **Education & Training**

FutureGrid key Concepts

- FutureGrid is an international testbed modeled on Grid5000
- Supporting international Computer Science and Computational Science research in cloud, grid and parallel computing (HPC)
- The FutureGrid testbed provides to its users:
  - A flexible development and testing platform for middleware and application users looking at interoperability, functionality, performance or evaluation
  - FutureGrid is user-customizable, accessed interactively and supports Grid, Cloud and HPC software with and without VM's
  - A rich education and teaching platform for classes
- Offers OpenStack, Eucalyptus, Nimbus, OpenNebula, HPC (MPI) on same hardware moving to software defined systems; classic HPC and Cloud storage

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4 Use Types for FutureGrid TestbedaaS

- **285** approved projects **(1500 users) January 13 2013**
  - USA(80%), China, India, Pakistan, lots of European countries
  - Industry, Government, Academia
- **Training Education and Outreach (14.7%)**
  - Semester and short events; interesting outreach to HBCU
- **Computer science and Middleware (56%)**
  - Core CS and Cyberinfrastructure; Interoperability (**3.3%**) for Grids and Clouds; Open Grid Forum OGF Standards
- **Computer Systems Evaluation (8.8%)**
  - XSEDE (TIS, TAS), OSG, EGI; Campuses
- **New Domain Science applications (20.5%)**
  - Life science highlighted (10.6%), Non Life Science (9.9%)
- Could emphasize Data Science and more experimentation by Government and Industry